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DEVELOPMENTS IN TRAINING AND MANPOWER TECHNOLOGIES

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THE U. S. ARMY IN THE 1970s:

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Mr. Morton and Dr. Maloy have given you an overview of some of the changes that are taking place in military education, in general, and in Navy education, in particular. I would like now to discuss some of the changes that have taken place in the U. S. Army and its education and training activities in recent years and to point up some of the implications these developments have for civilian education. Time will not permit me to touch on many such areas that might be of interest, nor to go into much detail on the others. Therefore, I will be guided by two points in my discussion: (1) I will seek to emphasize certain research developments that have particular relevance to civilian education; and (2) I will discuss certain Army research developments that are related to our Gulf Coast Region.

By way of background, the U. S. Army has for many years operated the largest educational and training system in our country, one that has been generally successful, and one that has done much to advance the general technology that underlies effective training and education. Many of the educational and training practices developed in the Army have found their way into public education and industrial training settings where they have been used with great effectiveness.

Military research on training can be traced back to World War I, at which time the U. S. Army was suddenly faced with the problem of quickly classifying and training almost two million civilian conscripts and volunteers. A group of psychologists under the direction of Dr. Robert M. Yerkes, an eminent psychologist from Yale University, was formed to attack the problem.

This group included some of the most famous men in the field of education and psychology such as Woodworth, Thorndike, Terman, Watson, Thurston, and Otis. Their development of the Army Alpha and Army Beta intelligence tests marked the beginning of group intelligence tests for both military and civilian use. So, much was done during World War I in the area of testing and classification that still affects our educational systems today.

But, training in the military services continued to be decentralized, highly personalized, and generally unstandardized in the Army up until World War II. Again, a period of sudden growth faced the military, one much greater than that of World War I and with much more complicated equipment to operate. General George C. Marshall, then Chief of Staff of the Army, was determined that training would be improved over that of World War I. Many actions were taken by the Army to improve its training in World War II, but perhaps the most significant was the initiation of an extensive behavioral research activity, the Army Air Forces Aviation Psychology Program. That program was a milestone activity, one to which most of the current programs described by Dr. Maloy can be traced. The systems approach to training, instructional systems development, instructional technology, the stress on media, the use of training devices and simulators, and many such current practices and procedures can generally be traced to this Army beginning in World War II. (For those of you who were not part of those exciting days of military yesteryear, this program was an Army development, for the Air Corps was then part of the Army and did not become a separate service until 1947).

After World War II, all three services continued research programs dealing with training and human resource problems. A major element of the Army research program since World War II has been that conducted by the Human Resources Research Organization, or HumRRO, which was organized in 1951. I was associated with HumRRO's aviation research for the Army at Fort Rucker

Alabama (near Dothan) from 1958 to 1975, As you perhaps know, Fort Rucker is another of the major military aviation activities in the Gulf Coast Region and has been the site of a substantial research effort over the years.

Having paid my deference to both history and geography, I would like to turn now to a brief discussion of Army research and programs dealing with the following areas:

- Performance-based instructional systems
- Education and training for lower aptitude personnel
- Uses of instructional technology in Army training

Then, finally, I wish to add a postscript that deals with an extension of these Army training technology efforts that relates to our nearby Gulf Coast neighbor city, Mobile.

Performance-Based Instruction

The first area I wish to discuss is that of performance-based instructional systems. Terms such as behavioral objectives, criterion referenced measurement, individually prescribed instruction, the systems approach to education, and the like are not foreign to most of you in public education, nor is the emphasis on learner-centered instruction as opposed to teacher-centered instruction. These approaches have been assimilated into the mainstream of American education, though I must say, not without controversy. What you may not know, however, is that to a considerable extent these approaches derive from research and development efforts conducted in the military dating back to the early 1950s.

One major emphasis of these efforts has been to focus on precisely what the individual does on the job, i.e., to identify the specific tasks he must perform and the supporting knowledge or cognitive material required to

perform those tasks. As a result, training curricula have been trimmed down to emphasize these "need-to-know" items. This focus on job performance requirements has not only made course content much more job relevant and functional, it has brought an emphasis on job performance in the instructional process and in the methods of evaluating performance during training.

This performance emphasis is evident in the basic training of all the services, but probably to the greatest degree currently in the Army. Instruction in the Navy and Air Force primarily involves a sequence of lecture-demonstration-practice, with written and performance tests of a normative nature, i.e., tests in which the trainee's performsnce is scaled in terms of his or her standing relative to that of other trainees. Also, for trainees whose basic reading skills are weak, both the Navy and Air Force share an emphasis on developing general literacy remediation instruction.

In contrast, the Army has instituted a performance-based instructional program that employs criterion-referenced testing for evaluation, i.e., evaluation with reference to a firm performance standard, or criterion, rather than relative to the performance of peers. Specific behavioral objectives, with standards and conditions, have been delineated and serve as the basis for both instruction and evaluation. Training is organized on the basis of six principles:

(1) Active Skill Practice. Emphasis is on active skill practice rather than more passive absorption of lecture information or talking about doing.

(2) Absolute Criterion. Every trainee is required to reach the same standard of performance in each skill. Assessment is on a "go/no-go" basis rather than testing by written tests using a 70-percent normative criterion.

(3) Functional Context. The trainee learns to perform in a job-relevant situation. Training is by performing and practicing tasks in the job context, rather than by cognitive subject-matter acquisition of a more abstract nature.

(4) Individualization. By practicing and performing a task to an absolute criterion, more leeway is given for the fast and slow learners. The program is individualized to allow the trainee to move at his own pace.

(5) Feedback. The instructor role is one of demonstrating skills, organizing skill practice, and checking the trainees' performance at the training site, rather than being primarily that of a medium for presenting information as in the traditional lecture approach.

(6) Quality Control. With performance-oriented training, trainees, instructors, and managers have a direct means of evaluation. Evaluation occurs at the end of each instructional period; a diagnostic evaluation test is administered half-way through the training cycle; and a comprehensive evaluation test is employed at the end of basic training.

How well does it work? Comparison tests of matched samples of trainees comparing this approach with the previous lecture-demonstration-practice approach employing a 70-percent normative criterion have shown marked superiority, across all mental categories, for personnel instructed by the performance-based approach. As a consequence, the Army is instituting this instructional approach on a wide basis.

A critical feature of performance-based, individualized instruction relates to the methodology for evaluating performance. As noted, the Army is moving away from normative evaluation toward criterion-referenced evaluation, for this is a key requirement for an effective performance-based instructional system. The Army is, therefore, presently engaged in a large-scale program of

training its instructional personnel and managers in the techniques and methodology of developing criterion-referenced performance measures. As you might guess, developing efficient and valid criterion-referenced performance tests is no simple matter.

Traditional military job instruction had tended to be fixed-pace, of fixed length, and to involve large classes. However, development of criterion-referenced tests for measuring specified learning objectives has forced course developers away from this model of fixed course length, with its consequent variability in amount learned by trainees, to a model of variable course length and standardization of what is learned and performed. It has also tended to move instruction more toward small-group instruction.

While I cannot go into further detail concerning the effectiveness of this performance-based, individualized instruction approach, Army results over a wide veriety of job training situations have shown savings of 25 to 30 per cent in training time with no loss in proficiency, and often with substantial increases in proficiency.

What, then, does this mean for civilian education? I think these techniques and procedures--i.e., job analysis, development of training objectives, emphasis on learning by doing, minimizing abstract or irrelevant subject matter, criterion-referenced measurement, absolute mastery, etc.--all can be and are being used to advantage in civilian education, whether it be in the schools or in industry. Basically, it is a matter of recognizing the differing capabilities and learning styles of individuals and fitting the instructional system to the individual. I am aware that this kind of change is easier said than done and that many educators resist the notion of having to specify what the student should be able to do (i.e., perform) after his education or training experience. I am also aware of the differences between the broad goals of general education and the more specific goals of

a job training program. Nevertheless, there are lessons here that are applicable in civilian education, and if as large, traditional, authoritarian, and hierarchical an institution as the U. S. Army can be changed toward this kind of recognition of the individual, then there is hope for other systems.

Education and Training of Lower Aptitude Personnel

I would like to turn now to my second topic, that dealing with research concerned with education and training of lower aptitude personnel. The preceding discussion of individualization in training has indicated the nature of gains that can be achieved through recognition of individual differences. However, Army manpower managers have had to consider even wider ranges of aptitudes than might have been suggested by this discussion. I would like to discuss some of the research and training programs that have resulted from this concern.

While the traditional instructional approach, with its stress on lecture presentations and use of written textual materials, was reasonably effective with students of average or above aptitudes and educational skills, for the less apt or the educationally deprived the system was not ideal. One consequence was that the pace of instruction was geared to the slower students and tended to bore the faster, more apt students. As a result, achievement levels for both groups were generally depressed.

In the mid-1960s a policy decision was made that a large number of lower aptitude personnel (AFQT Category IV) would be inducted into the Army, and a research program to develop training methods better suited for such personnel than were the traditional instructional methods was begun. As the Army entered the 1970s, it was also moving toward an all-volunteer force as a result of another major policy decision. Concurrent with these actions there was also mounting pressure on all agencies of the federal

government, including the Army, to improve the employability of minority and disadvantaged persons.

One aspect of this research was to develop training methods to increase the performance effectiveness of lower aptitude personnel. The emphasis on performance-based instruction and learning by doing, previously described, was one thrust of the program. While the training technology on which this thrust was based derived largely from sources other than that of accommodating instruction to lower aptitude personnel--for example, the major emphasis on use of programmed instruction for technical training courses by the Air Force--the performance emphasis was well-suited to the needs of this much broader aptitude group entering the Army.

Results of this research have shown that these lower aptitude personnel can master technical job skills quite satisfactorily, given proper instruction. The training focus on performance and mastery has allowed most such individuals to complete their training and to perform on the job in a satisfactory manner. I do not mean to suggest that this approach is a panacea and that everyone is capable of everything, but it has demonstrated that persons we might have thought untrainable or unemployable for skilled jobs, civilian and military, are capable of quite satisfactory performance, given the proper training. As you are aware, there has been, and currently is, much debate about the viability of the volunteer Army concept. I do not intend to discuss that aspect here. For example, there are questions of motivation to perform, conformity to the "establishment" way of doing things, the overall quality of personnel in our armed forces--these are important questions--but, the fact is that the Army has made effective performers of large numbers of lower aptitude personnel. Recent years have seen the development of similar educational

programs and approaches in the civilian sector, and while I would by no means suggest that all pioneering research and development in this area has occurred in the military, I do believe the military has led the way and has made a significant contribution to educational technology in this area of concern to our society.

A second major thrust of the Army's program for lower aptitude personnel has been with respect to literacy training. The reading skills deficiencies of many military recruits have already been mentioned. The Army's approach to literacy remediation training differs from that of the Navy and the Air Force in two major ways. First, it emphasizes job-functional literacy instead of general literacy, and, second, remediation training occurs at the end of basic training rather than before recruit training begins.

The emphasis on job-functional literacy is based on two of the six general principles underlying performance-based instruction that I described earlier; the functional job context for instruction, and active skill practice. The term "functional context instruction" is one that derives from HumRRO research conducted in the 1950s on the training of electronics maintenance technicians. At that time Army technical courses were organized in a fashion that is still rather general today--i.e., the student was first exposed to the "fundamentals" such as basic electricity, electron flow, Ohm's Law, and the like, and then, having a grasp of the underlying theory, he received actual job practice. This is pretty much the traditional "lecture-demonstration-practice" approach described earlier.

Analysis of this instruction indicated two things: (1) the student had to master much general theoretical information that he never used on the job, and (2) that portion which was relevant was not remembered well or could not be related to the job at hand. Consequently, we evolved the functional context instruction approach in which the student was immediately

introduced to the equipment he was to maintain, and abstract or theoretical material was only introduced into the instruction when and if it was necessary to the job tasks to be performed.

Not only has this approach allowed some dramatic reductions in the length of training--some courses were reduced 50% or more--it has resulted in better learning and superior job performance. Perhaps the main reason is that the student is able to develop a meaningful cognitive or mental structure, one based on job activities and needs, that allows him to assimilate the abstract material more effectively and to retain it better. The advantages of this approach to instruction have been quite marked for the lower aptitude personnel, but we have found it also to be quite advantageous with higher aptitude personnel, as in flight training programs.

Thus, the Army literacy program is based on job-relevant reading materials that are meaningful to the trainee. Emphasis is on the acquisition of instrumental coping skills in the trainee's area of job interest, rather than on more general or abstract reading material or rules of grammar and syntax. This approach has been shown to be highly effective, and the other services will likely move in this direction also. The lessons here for civilian education have not gone unnoticed, and similar efforts and programs are underway there.

Thus, in response to what is essentially a manpower problem resulting from the all-volunteer force and other factors, the Army has taken active and effective steps to alleviate that problem through training innovations that provide more effective and efficient instruction for personnel over a very broad spectrum of aptitudes and educational background. Much of this work is applicable in the civilian world to improving the employability of the substantial segment of our society that has seemed unable to cope

with the ever-increasing educational requirements of modern technology.

Instructional Technology in Army Training

The term "instructional technology" covers the multitude of devices, media, aids, and gadgets that have arisen in both military and civilian education in recent years. While teachers have used a variety of devices to aid their instruction for many years--probably well before any recorded history of education, and one might even include the hickory switch here as a means of feedback or knowledge of results--the past 35 years have seen a real proliferation in this area. For example, just after World War II the American Council on Education surveyed educators concerning what they felt to be the most outstanding features of military training. Not only was there almost unanimous agreement that the single most outstanding feature was the use of visual aids in training, it was estimated that the quantity of visual aids produced and used by the Army and the Navy between 1940 and 1945 was about six times the quantity of such material created for use in all civilian education up to that point in time.

This media explosion has continued to the present time, and many of us wonder if sufficient attention is given to the content of such media and how the media are used in instruction. But, perhaps the most important changes in instructional technology of recent years have been those relating to uses of the computer. In the areas of computer-managed and computer-assisted instruction, the Army has been very active along with the other services. Time will not permit me to go into that area, but it is one in which much as been and will be done. The aspect of computer use in military instruction with which I have had most contact, and one from which tremendous increases

in training effectiveness and efficiency have occurred, is that relating to the development and use of flight simulators.

While the Army did not pioneer the development of flight simulators --that goes back primarily to civilian sources in the 1930s--it did, I believe, make the first substantial use of flight simulators to reduce aircraft flying hours required in a military flight training program.

The impetus for this type of development stemmed from the digital computer advances of the 1950s and 1960s and their implications for training. The capabilities of the digital computer allowed the Army to develop a concept of simulation design based primarily on training considerations rather than on aircraft or hardware considerations. This conception eventually led to the development of a family of highly effective helicopter flight simulators now in use by the Army at Fort Rucker.

In our evaluation of these devices, we found that we were able to accomplish instrument flight training objectives that had previously required 60 flight hours in an average of less than seven flight hours following training in these simulators with a specially designed training program. I emphasize the training program design here, for with simulators, as with any of the instructional technology innovations, it is <u>how the medium is used</u> that is really the critical factor in its success.

While the Army simulators to which I refer really marked a new generation of simulation in terms of their unique designed-for-training features, we have no doubt that the 90% reduction of flight time that we found was due in large part to the training program. At the risk of being repetitious, I would note that the characterisitcs of that program were the same as the six principles I gave you for performance-based instruction. We have seen

other flight simulators of similar design used with much lower flight substitutability rations, a factor we believe is reflective of the manner in which the device is used.

All the services are moving heavily in the direction of simulation. It provides better training in many areas, is more cost effective, and now, with the fuel crisis, is fast becoming an absolute necessity.

These simulator development and testing activities took place at Fort Rucker, Alabama. The Army has, as I have indicated, been a real pioneer in the effective use of flight simulation and is continuing to move out smartly in that area. The other services, because of their much higher flight training costs, are also moving out smartly in their simulation programs.

I plan to close with discussion of a military training technology development that is located in Mobile, though it is not Army, Navy, Marines, or Air Force. It concerns our other military service, the U. S. Coast Guard. The Coast Guard, in addition to its seagoing activities, has a very able aviation element involving both helicopters and fixed wing aircraft. Coast Guard aviation is principally concerned with search and rescue missions, though pollution control and shore surveillance are increasingly important mission areas. As some of you may know, the Coast Guard Aviation Training Center is located in Mobile, Alabama, a Gulf Coast city. I might note that the ring of aviation training installations that ranges from Corpus Christi, Texas through Keesler Air Force Base, Mississippi, Mobile, Pensacola, Eglin Air Force Base, Fort Rucker, Tyndall Air Force Base, and down to MacDill Air Force Base in Tampa makes the Gulf Coast area truly the golden crescent of military aviation training.

In 1970 the Coast Guard aviation training program was redesigned from the ground up. This effort was able to profit greatly from the Army experience described, and, as a consequence, we were able to develop what we feel to be the best application of the systems approach in a military flight training program to date. It is a program in which instruction is performance-paced and individualized. Further, the flight simulators were designed for maximum training effectiveness and are used that way. The Coast Guard, as a result of its receptivity to innovative applications of advanced training technology, now operates what we feel may be the most effective and efficient military flight training program in existence. Not only that, the cost savings from this new training system are significant, even though the Coast Guard is not a large service. The entire training system development effort, including the procurement costs for simulators for each of the two Coast Guard helicopters, cost a total of $3.1 million. Annual cost savings, based on 1973-74 operating data, total about $2.6 million per year, so this has been an extremely cost effective application of training technology.

In closing, I do feel that there are applications of these Army manpower and training technology developments that can be made in public education and in business and industry. While most such applications could not afford to spend $3 million for a simulator, neither do they need such a simulator. In our simulation research we have found that highly effective training can be given using paper training devices that cost literally only a few cents each. The important thing is to focus on the behaviors or skills to be learned, to develop an environment conducive to learning, and to evaluate performance in objective fashion. The systematic approach to

such problems that has been pioneered by the Army and the other services has already had a great impact on non-military education and training and will have even greater impact in years to come. While the military research and development efforts leading to these advances have taken place throughout the nation, the Gulf Coast Region has been the site for a significant portion of that research, particularly in the field of aviation, and will undoubtedly continue in that role for years to come.

Thank you.